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DESIGN OF WATTS PROCESS CONTINUOUS CASTING MACHINE FOR TUBE HOL--ETC(U)
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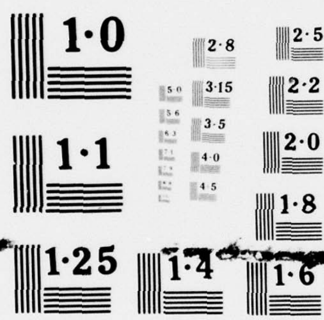


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MICROCOPY RESOLUTION TEST CHART

- FINAL REPORT -

CONTRACT NO. DAAG46-76-C-0041

AD

(11)

(18) AMMRC (19) CTR-77-2

TITLE (6) DESIGN OF WATTS PROCESS
CONTINUOUS CASTING MACHINE
FOR TUBE HOLLOWS.



DATE (11) Jan[redacted] 1977 (12) 15p.

AUTHOR(s) (10) Leonard Watts [redacted] Henry Allen

COMPANY Technicon Instruments Corporation

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(9) FINAL REPORT, (15) CONTRACT NUMBER DAAG46-76-C-0041

May 76 - Jan 77,

Approved for public release; distribution unlimited.

Prepared for

ARMY MATERIALS AND MECHANICS RESEARCH CENTER
Watertown, Massachusetts 02172

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| 3. RECIPIENT'S CATALOG NUMBER | |
| 4. TITLE (and Subtitle): DESIGN OF WATTS PROCESS CONTINUOUS CASTING MACHINE FOR TUBE HOLLOWS | 5. TYPE OF REPORT & PERIOD COVERED: Final Report May, 1976-January, 1977 |
| | 6. PERFORMING ORG. REPORT NUMBER |
| 7. AUTHOR(s): Leonard Watts and Henry Allen | 8. CONTRACT OR GRANT NUMBER(s): DAAG46-76-C-0041 |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS: Technicon Instruments Corporation, Tarrytown, New York 10591 | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: D/A Project: M757590; AMCMS Code: 32970M7590; Agency Accession: |
| 11. CONTROLLING OFFICE NAME AND ADDRESS: Army Materials and Mechanics Research Center, Watertown, Massachusetts 02172 | 12. REPORT DATE: January, 1977 |
| | 13. NUMBER OF PAGES: 5 |
| 14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) | 15. SECURITY CLASS. (of this report): Unclassified |
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Watts Process
Steel
Continuous Casting

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This work covers the design of a prototype Watts Process continuous casting machine for producing up to 5 1/2 inches O.D. steel hollow tube blanks in short lengths.

## FOREWARD

This report on "Design of Watts Process Continuous Casting Machine for Tube Hollows" covers the work performed under Contract DAAG46-76-C-0041 under the direction of Technicon Corporation, from May, 1976 to December, 1976.

The project was supported by the Army Materials and Mechanics Research Center, Watertown, Massachusetts. This work was under the technical supervision of Mr. Arthur Ayvazian of AMMRC.

## ABSTRACT

This work covers the design of a prototype Watts Process continuous casting machine for producing up to 5 1/2 inches O.D. steel hollow tube blanks in short lengths.

## BACKGROUND

In late 1973 an official of Technicon Corporation visited the Army Materiel Command in Alexandria to discuss Technicon's patented process for casting steel in both solid and tubular form. At that time Technicon learned of a procurement problem relating to gun barrels and similar forged products. The essential problem as described was that steel which is made by pouring ingots, or by vertical continuous casting, does not meet the high quality standards which are needed for these weapons. Both ingot and continuously cast steel are somewhat deficient in that they are subject to porosity and segregation. Accordingly, AMC has found it necessary to rely essentially on electroslag refined steel as a feed material for both its present forging operations and its new rotary forging press. Although steel from this process readily meets quality specifications, other alternate methods are constantly being explored.

We were asked at the early meetings about both the economics and the quality possibilities of steel made in our unique horizontal continuous casting process. Our initial response was that the process would be considerably less expensive not only than the ESR process but also than conventional continuous casting or ingot-pouring. From a quality standpoint, at that time, we could only estimate that our quality would be superior to both ingot-poured steel and vertical continuously cast steel, while not as good as the ESR product. AMC reasoned that our process should be looked at further to determine where steel made in the process would fall in the quality spectrum. We understood that to some extent the ESR grades being used were "overkill" from a quality standpoint, but at the moment their high cost could not be avoided because of the quality deficiencies of steel made by other methods.

Subsequently, a test by AMC of the material made by Technicon using the Watts Horizontal Continuous Casting Process revealed that its quality was not only appreciably superior to either the ingot-poured or the conventionally continuously cast product, but in certain aspects it even approached the quality of the expensive ESR product. In addition, of course, both the capital investment and the operating costs of the Watts Process are appreciably lower. For these reasons it appears that material made in our process should be very desirable for the special military purposes under consideration.

While these judgments are based on production and evaluation of billets cast in solid form, the same basic principles would be used and the same quality advantages will occur in using the process to produce hollow rounds. The production of hollows, however, requires equipment of a somewhat modified design, although the basic concepts of the closed-end mold process are the same for hollows as they are for solids.

## Operation of the Horizontal Tube Blank Caster

The horizontal closed-end mold tube blank machine as designed in this program is seen in Figure 1. The operating sequence of the machine is illustrated schematically in Figure 2. Prior to casting the tundish is preheated, the flame emerging from the tundish nozzle serving to preheat the mold plug. On completion of preheat, the mold is pushed over the tundish nozzle into the casting position (Figure 2-1). Metal is poured from the melting furnace into the preheated tundish. The metal flows through the tundish nozzle and fills the mold cavity (Figure 2-2). After a delay of a few seconds to allow freezing onto the anchoring bolts on the tundish nozzle, the mold is slowly withdrawn from the fixed tundish. The mold withdrawal rate is gradually accelerated to the aim casting speed which should be achieved within 60 seconds of the start of pouring. During this time metal is being poured from the melting furnace into the tundish. The tundish is not replenished during the cast; therefore, as casting proceeds, the metal level in the tundish gradually falls (Figure 2-3). Liquid metal supply from the tundish to the liquid core of the cast strand continues until the metal level in the tundish falls below the level of the nozzle. Casting beyond this strand length results in an infilling of the mold cavity by the still liquid core of the cast section. The liquid core, in turn, drains towards the mold. Casting is complete when all the liquid core has been converted to solidified outer shell (Figure 2-4). The slag/metal reservoir remaining in the tundish is drained through a slide gate valve mounted in the base of the tundish.

## Future Work

A three-phase program has been planned for the "establishment of production base for Watts Process products". Phase I which was funded and completed, has covered the complete design of a Watts Process Tube Hollow Continuous Casting Machine for producing rounds up to a maximum of 5-1/2" diameter in short lengths. A complete set of manufacturing drawings is now available.

Phase II, depending on future funding, will involve construction of the prototype machine in accordance with the Phase I design, equipment installation, start-up and debugging, demonstration of the process, and evaluation of products made in the process.

Contingent on the success of Phase II and the availability of funding, Phase III would involve the design, construction, and installation of a commercial size machine which would provide the Army Materiel Command with all its requirements of high quality, hollow feed stock for its rotary forging machines on an attractive economic basis.

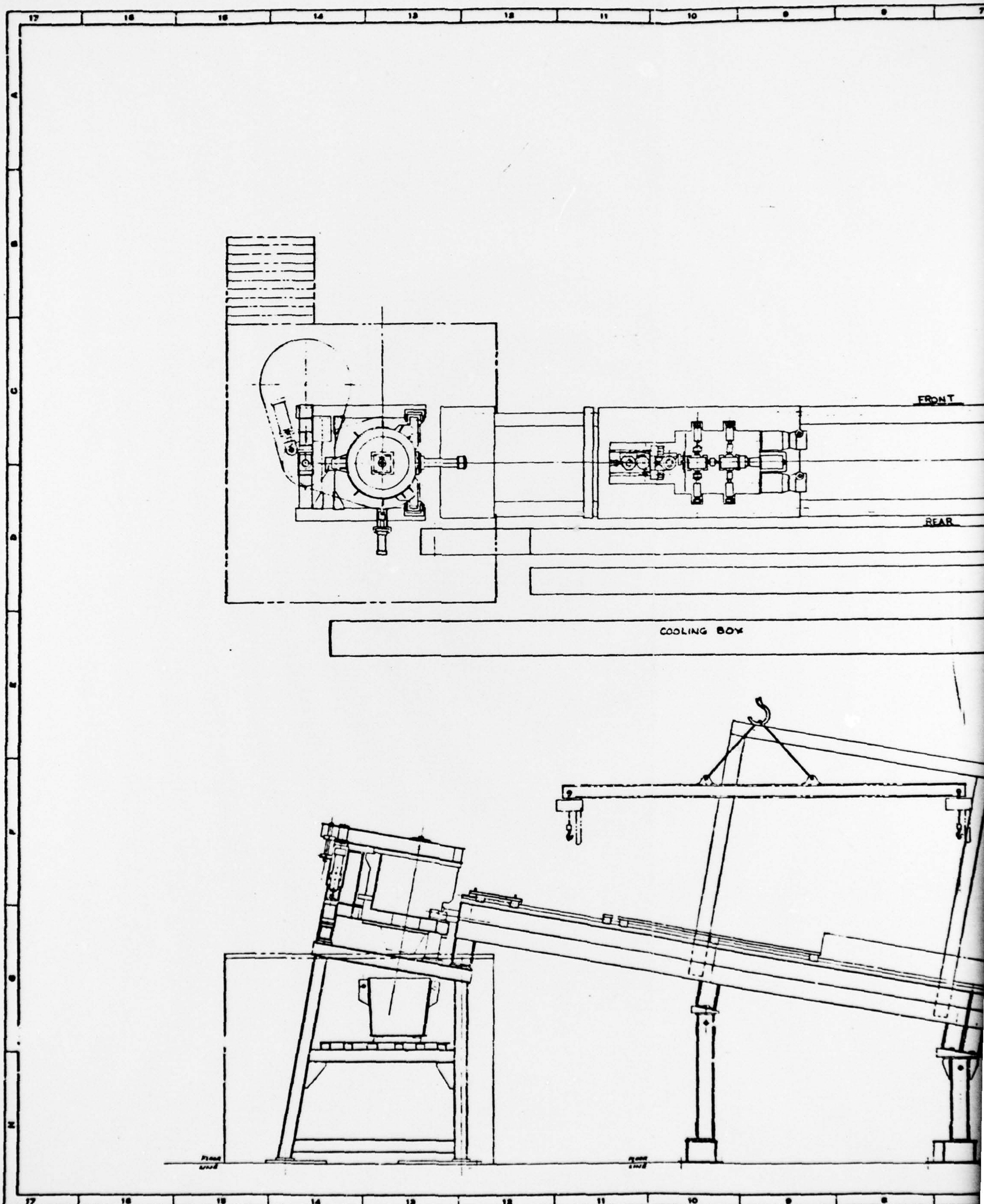


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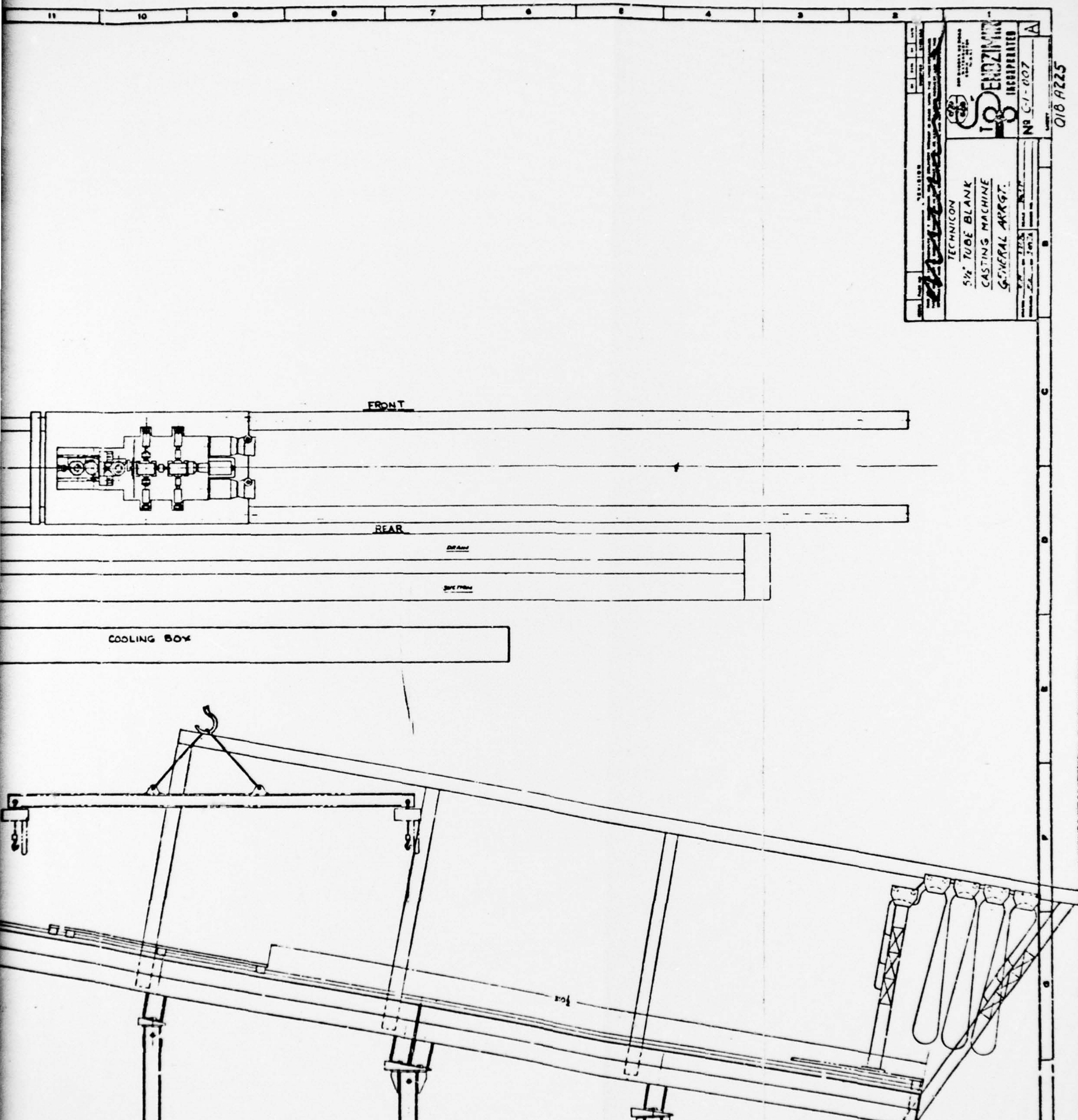
FIG. 1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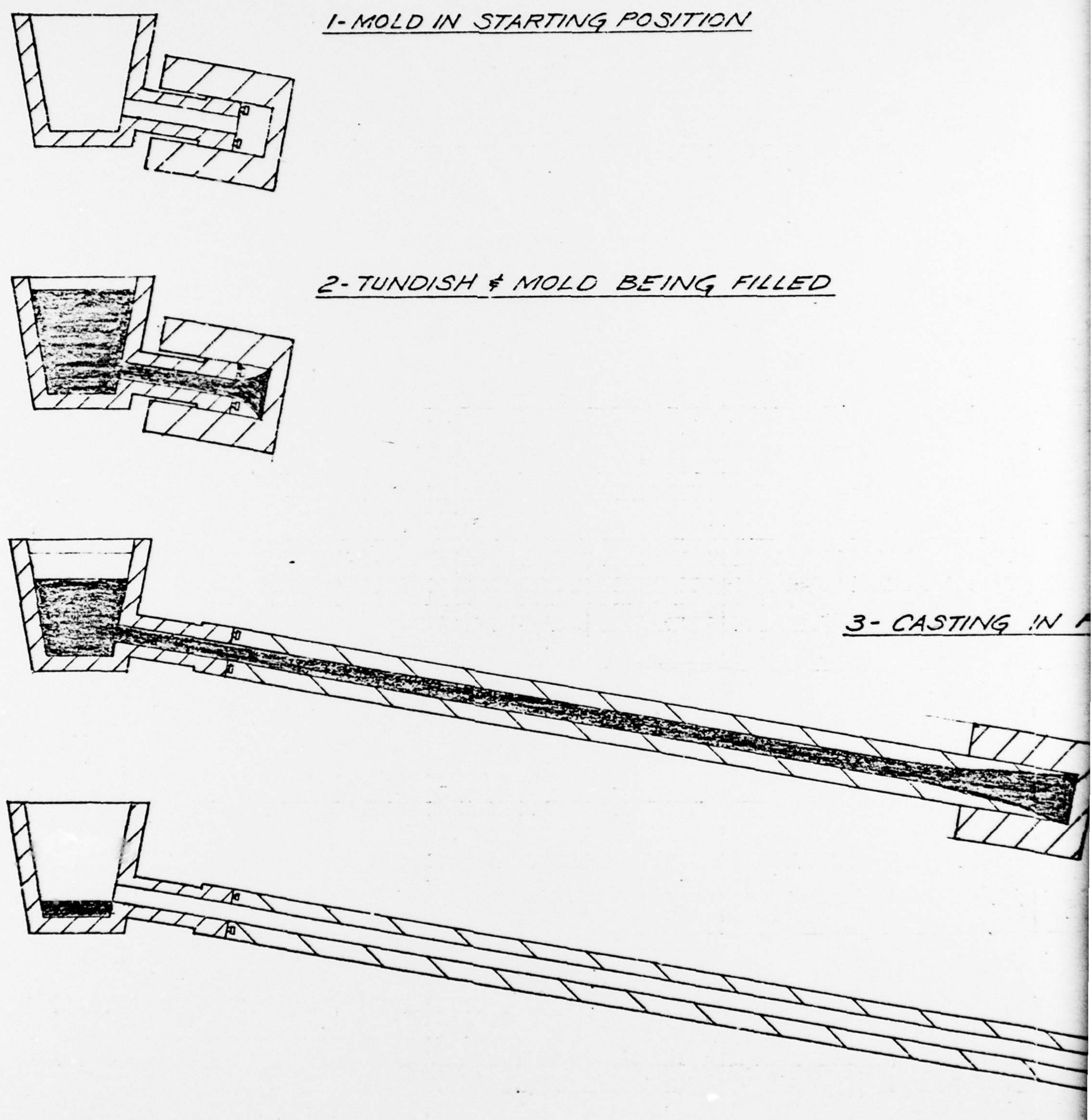
TECHNICON
5½" TUBE BLANK
CASTING MACHINE
GENERAL ARRGT.
SENDZIMIR
INCORPORATED
Nº C-1-007
Q18 A225

FIG. 2

OPERATING SEQUENCE OF HORIZONTAL

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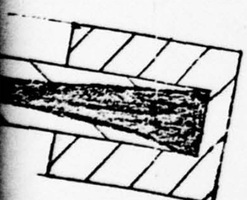
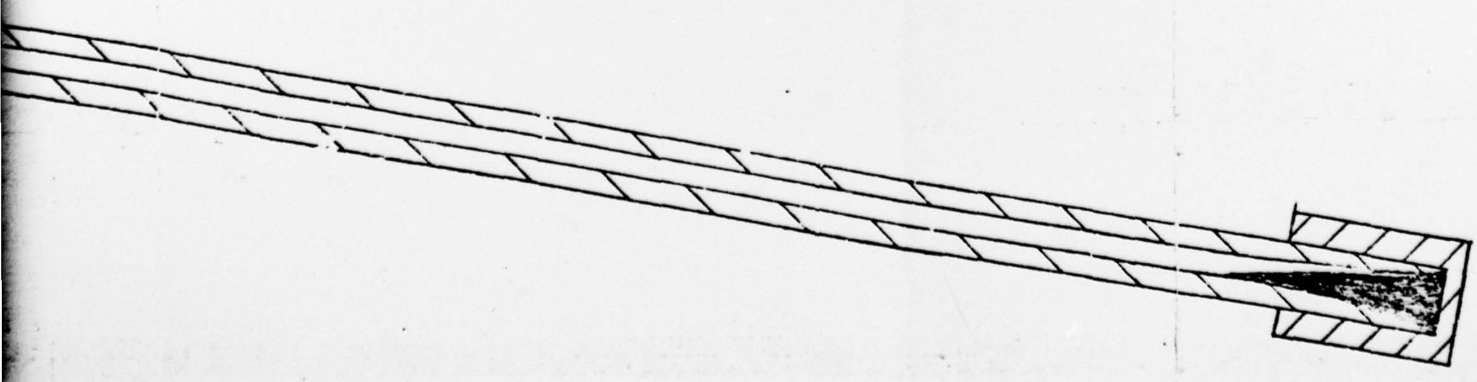
2
ORIZONTAL TUBE BLANK CASTER

STING IN PROGRESS



4-HOLLOW CASTING COMPLETED



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Technical Report AMMRC CTR 77-2, January, 1977, 5 pp - 2 illustrations, Contract DAAG46-76-C-0041 D/A Project M757590, AMCMS Code 32970M7590, Final Report, January, 1977

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